Fishery Data Series No. 98-17

Distribution of Mature Sea-run Cutthroat Trout from Sitkoh Creek, Alaska in 1996

by

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and

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August 1998

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$ etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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ABSTRACT

We radio-tagged mature cutthroat trout leaving Sitkoh Lake in the spring of 1996 to track them from their overwintering site to their natal streams. Thirty fish were successfully tracked and 27 of those went to one stream at the head of Sitkoh Bay. The other three were tracked into two small streams on the north shore of Peril Strait. Regurgitation was a considerable problem in this study, with 31 of the original 56 tags being regurgitated in lower Sitkoh Creek. All fish were held for 24 hours after tag insertion, but only 6 tags were regurgitated during the holding period.

Key words: Alaska, Sitkoh Creek, cutthroat trout, radiotelemetry, sea-run, weir.

INTRODUCTION

The freshwater sport fishery in the Sitkoh Lake drainage (Figure 1) harvests an annual average of 240 (the peak harvest was 647 trout in 1993) cutthroat trout *Oncorhynchus clarki* and has an average catch of 1,757 (Mills 1991–1994, Howe et al. 1995–1996). A significant portion of the trout harvest and catch is thought to be sea-run cutthroat trout natal to other systems that use Sitkoh Lake to overwinter. Effective management of this fishery should take into account the mixed-stock nature of this population, and, ideally, the status of contributing stocks/streams. In addition, because most streams near Sitkoh Lake have been clearcut, and because logging can result in reduced cutthroat trout abundance (Behnke 1992, Lucas 1980, Martin et al. 1981), identification of the natal streams for fish overwintering in Sitkoh Lake may be important to management of this fishery.

To address these questions, we inserted radio tags in a sample of mature cutthroat trout as they emigrated from Sitkoh Lake and then flew weekly aerial surveys in an attempt to locate tags using on-board radio receivers. Analysis of data is based on the assumption that mature fish migrate immediately to the stream in which they will spawn. Our primary objective was to detect with 95% confidence the six most important streams which together received 60% or more of the 300-mm-fork-length wild cutthroat trout that overwintered in Sitkoh Lake .

METHODS

We installed and operated an aluminum bipod and picket weir just above tidewater on the outlet of Sitkoh Lake and captured all downstream migrating cutthroat trout. All captured, emigrant fish were measured for fork length, had scales removed for age determination, and were marked with a uniquely numbered Floy tag and by excision of the adipose fin (Yanusz 1997). Fifty-six emigrants ≥300 mm FL were drawn systematically from the population and given a radio tag by esophageal implant. The 300-mm minimum size was based on data from Lake Eva (Armstrong 1971) that indicated that all emigrants of this size should be sexually mature and other data that suggested these fish should be capable of carrying the radio tags employed in this study.

Advanced Telemetry Systems (ATS) transmitters were used in this experiment. The tags are 3/8 inch in diameter, 1 inch long, and broadcast at 152 Mhz. Each transmitter weighed 5.0 g, which is about the maximum (2% of the body weight) for a cutthroat trout 300 mm in length (Winter 1983). The 10-inch long antennas for each transmitter protruded from the mouth of the fish.

The objective criteria for the project was determined from a Monte Carlo Simulation in which we assumed: 1) 59 emigrants of taggable size; 2) a maximum travel distance from Sitkoh Lake of 40 miles, a distance that encompassed 29 spawning streams; 3) the length of each stream determined its relative importance as a spawning stream, and; 4) that irrecoverable tag loss would be about 20%. We assumed a population size of 439 taggable cutthroat trout emigrants based on a previous study at Sitkoh Lake (Banta 1938) and the proportion of mature emigrants (i.e. fish ≥300 mm FL) observed at Lake Eva (Yanusz and Schmidt 1996). As the simulation showed 56 transmitters would be adequate to meet the objective criteria,

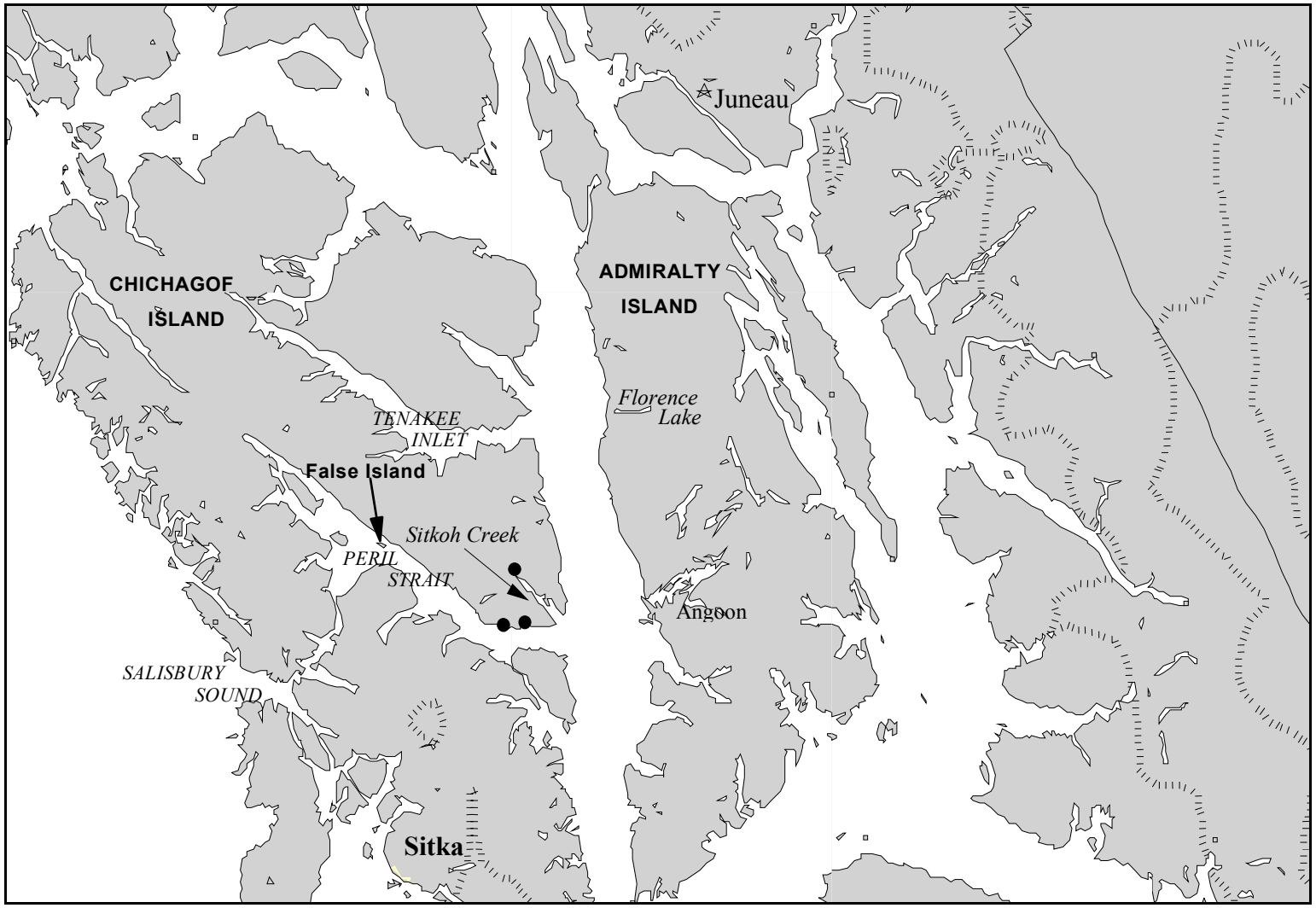

Figure 1.–Location of Sitkoh Creek in northern Southeast Alaska. Black dots indicate streams that cutthroat trout were tracked into.

the tagging rate was initially fixed at one tag for every fifth fish. Tagging began on April 13, but by April 28, the projected number of emigrant fish was estimated to be much larger than originally expected, and the tagging rate was decreased to 1 in 20 fish $\geq$300 mm.

Each fish had a tag inserted down the esophagus and into the stomach using the methods described in Waters 1993. The fish were then held in a pen for 24 hours to detect short-term (24-hour) tag loss. Tags that were regurgitated and recovered from the holding pen were inserted in a new fish and the holding process was repeated. Fish that held their tag for 24 hours were released. Similarly, if a fish regurgitated its transmitter in the stream below the weir and the transmitter could be recovered, it was inserted in a new fish and held as described above.

Aerial surveys were used to locate fish with transmitters in other freshwater systems after they left Sitkoh Creek. Aerial receivers employed wing-mounted antennae. We used ATS receivers and ATS DCC II dataloggers with software to recognize pulse coded tag transmissions. The receiver and dataloggers were connected to directional antennas mounted on each wing of a DeHaviland Beaver fixed-wing aircraft. Aerial surveys commenced after five radio-tagged cutthroat trout had been released from Sitkoh Creek and were repeated every seven days (weather permitting) until the end of June. Because our radio transmitters emitted high frequency signals, reception was "line of sight" with a range of about 1 kilometer; mountainous terrain prevented reception of signals between drainages. Because our aerial tracking was at or below the ridge lines at less than 500 feet above ground level, transmitters could be located and assigned to a drainage.

Aerial surveys provided information adequate to assign tags to a watershed but many times were of insufficient resolution to accurately locate tags within a watershed. Also, locating a transmitter from the air did not provide information on whether the tags were retained by a fish or had been regurgitated. Similarly, they did not provide information on whether a fish was alive or dead, or provide information as to whether the fish would or had spawned in a given drainage. We sought to overcome these difficulties by conducting foot surveys to determine the status of individual fish located from the air. The ground surveys were scheduled as manpower and weather permitted. The position of transmitters were to be determined with the use of hand-held receivers. Technicians could then attempt to determine if tags had been regurgitated, if tagged fish were alive, note the presence of cutthroat trout redds and spawning habitat, and to recover any regurgitated tags.

Aerial surveys began on April 19 and continued through June 26, 1996. On each survey, the radio tracking flight started at the south entrance to Tenakee Inlet and included all anadromous streams from there down Chatham Strait through Sitkoh Bay and along the north shore of Peril Strait to False Island. On three flights (May 2, June 5, and June 26), we extended the limits of the aerial survey to include streams on the south shore of Tenakee Inlet from Finn Cove out to Chatham Strait, streams up Peril Strait to Broad Island, the south shoreline of Peril Strait from Cozian Reef to Pt. Thatcher, and the west shoreline of Admiralty Island from Angoon to Florence Lake. No transmitters were detected in any streams in the extended portions of the three longer surveys.

The estimated proportion $\hat{p}_{ah}$ spawning in each stream was computed:

$$\hat{p}_{ah} = \frac{n_{ah}}{n_h}$$

$$var(\hat{p}_{ah})\left[1 - \frac{n_h}{N_h}\right]\frac{\hat{p}_{ah}(1-\hat{p}_{ah})}{n_h - 1}$$

$$\hat{p}_a = \frac{1}{N}\sum_h N_n \hat{p}_{ah}$$

$$var(\hat{p}_a) = \sum_h W_h^2 \; var(\hat{p}_{ah})$$

where $\hat{P}_{ah}$ is the estimated proportion of the population in temporal strata h destined for stream a, n_{ah} is the number of fish marked in strata h and successfully tracked to location a, n_h is the number of fish marked in strata h and successfully tracked to any location, N_h is the total number of fish counted at the weir in stratum h, $Wh = Nh/N$, and $N = \sum N_h$. The formula is an approximation that assumes $1/N_h$ is negligible (Cochran 1977).

RESULTS

From April 10 to June 12 a total of 3,955 cutthroat trout emigrated from Sitkoh Lake; 1,696 of these (44%) were ≥300 mm FL and assumed to be mature sea-run trout (Yanusz 1997). Mature fish tended to leave the lake first followed by immature fish (Figure 2). The first radio-tagged cutthroat trout was released below the weir on April 13 (Appendix A1), and tagging continued through June 14.

Tag regurgitation was frequent during the study. Of the original 56 tags available for insertion, 31 were regurgitated and recovered below the weir in lower Sitkoh Creek; these tags were reinserted in newly caught emigrants. Six additional tags were regurgitated in the 24-hour holding period in the holding pen at the weir. These tags were also reinserted in newly caught emigrants. Thus, 73 different trout had transmitters inserted into their stomachs during the course of the study.

There was no significant difference in rates of tag regurgitation relative to migratory timing (Figure 3): rates of regurgitation for the first half of the run (April 13 to April 29) were not significantly different ($\chi^2 = 0.004$, P = 0.94, df = 1) from the latter half. Nor were there differences in regurgitation rates between males and females ($\chi^2 = 1.21$, P = 0.27) (Table 2). However, the fish that regurgitated tags tended to be smaller (Mann-Whitney test statistic = 379.0, P = 0.004, df = 1) than fish that retained their radio tags (Table 2 and Figure 4).

Thirty fish bearing radio tags were detected in nearby streams during aerial surveys (Table 1, Appendix A2). Of these, 27 were located in Sitkoh River (113-59-10070 ADF&G Anadromous Stream Catalog Number), a large stream system at the head of Sitkoh Bay in a drainage separate from Sitkoh Lake. Two tags were located in drainage 113-51-10048 and one in drainage 113-51-10060, both streams located on the north shore of Peril Strait. One tag was regurgitated on the beach in outer Sitkoh Bay. No radio-tagged trout were believed to have remained and spawned in lower Sitkoh Creek, although we did recover 14 regurgitated tags from lower Sitkoh Creek at the end of the study. The remaining transmitters were never heard again but were probably regurgitated in salt water (from where we are unable to receive the radio signal).

We estimate that 94% of the mature outmigration, SE = 3.9% (1,352 cutthroat trout) migrated to Sitkoh River, 3.5%, SE = 2.9% (50 cutthroat trout) traveled to stream 113-51-1004810048, and 2.8%, SE = 2.8% (41 cutthroat trout) traveled to 113-51-10060. Since the tagging fraction changed during outmigration, the calculated percentages were weighted by the strata sample sizes. Thus, we partitioned the data into three seasonal strata based on actual changes in tagging fractions (i.e., those due to tagging rates and tag loss, see Table 3). The size and maturity of cutthroat trout also changed over time, with the larger, mature fish outmigrating first (Figures 2, 5, and 6) followed by smaller, immature fish. For the expansions, we used only fish that outmigrated prior to May 23, 1996, because after that date the average daily length of fish dropped to well below 300 mm (Figure 5), and no obviously mature fish were observed outmigrating through the weir (Figure 6). The size of emigrants before and after May 23 is further illustrated in Figure 7.

The travel time from Sitkoh Creek to destination streams was estimated from the release and aerial survey data. Although the individual travel time estimates are biased because of the discrete weekly surveys flights, the median (or average) values and the inter-quartile ranges (or standard deviations) should be fairly accurate for large samples. The time for fish to travel the approximate 3.8 km to Sitkoh River ranged from 2 days

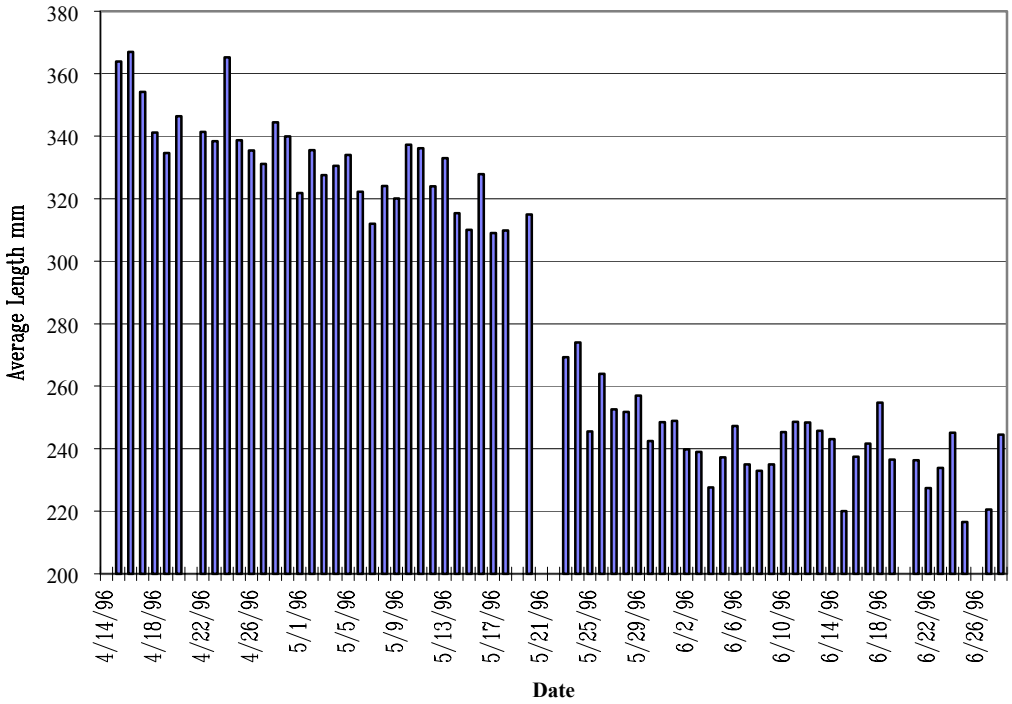

Figure 2.–Cutthroat trout average length by day at Sitkoh Creek weir, 1996 (days with fewer than five fish were not included in the graph).

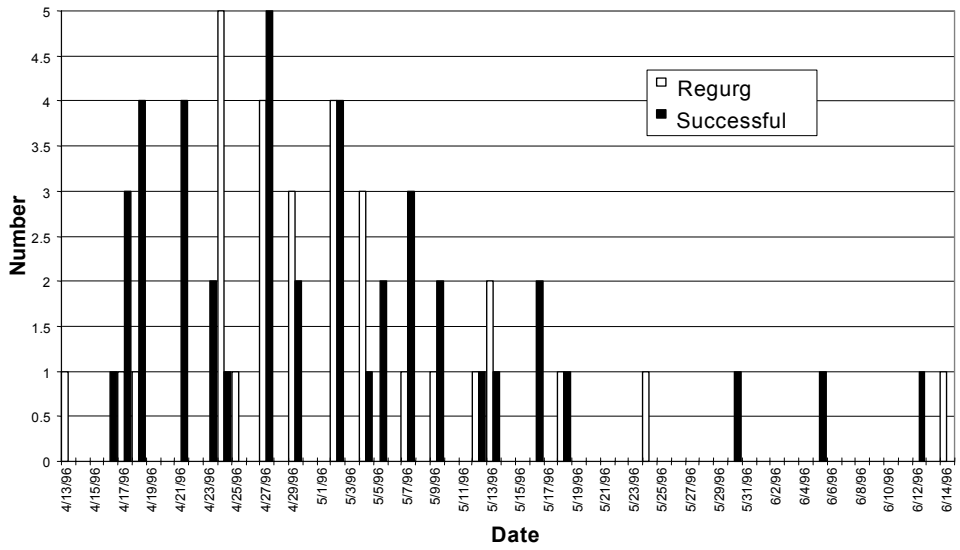

Figure 3.–Dates and numbers of fish successfully radio-tagged and fish that regurgitated tags during the 1996 Sitkoh radio-tagging study.

Table 1.–Radio tags tracked into streams, the date the tags were released, the first date the tag was seen in the stream and the number of days from release to the first observation.

Stream no.	Distance from Sitkoh (km)	Frequency	Code	Date released	Date first observed	No. of days
113-51-10048	20.8	152.164	18	5/2	5/8	6
		152.344	17	4/29	5/2	3
113-51-10060	15.7	152.103	18	5/2	5/22	20
113-59-10070	3.8	152.013	14	4/24	5/2	8
		152.013	17	4/27	5/2	5
		152.045	18	5/2	5/8	6
		152.103	14	5/13	5/15	2
		152.103	17	4/27	5/8	11
		152.134	14	4/27	5/8	11
		152.134	19	5/9	5/15	6
		152.164	14	4/27	5/8	11
		152.194	18	5/2	5/8	6
		152.194	19	5/5	5/8	3
		152.254	14	4/24	5/8	14
		152.254	18	5/16	5/22	6
		152.254	19	5/7	5/15	8
		152.314	14	4/24	5/8	14
		152.314	17	4/29	5/8	9
		152.344	14	6/5	6/12	7
		152.524	14	4/18	4/23	5
		152.524	17	4/17	4/23	6
		152.524	18	4/23	5/2	9
		152.524	19	4/21	4/23	2
		152.554	14	4/18	4/23	5
		152.554	18	4/17	5/2	15
		152.584	14	4/18	5/2	14
		152.584	17	4/17	4/19	2
		152.584	18	4/21	4/23	2
		152.614	14	4/21	5/2	11
		152.644	14	4/18	4/23	5

to 14 days (Table 1), with a median travel time for the 3.8 km of 8 days (0.5 km/day). The two cutthroat trout that were tracked to stream 113-51-10048 took 6 days (3.5 km/day) and 3 days (6.9 km/day) to cover the 20.8 km distance. The fish that took three days was a mature 316-mm FL male, the other fish was an immature 386-mm FL female. The trout located in 113-51-10060 required 20 days to travel 15.7 km. This was a 372-mm female listed as immature at tagging.

Foot surveys were limited because the field crew at the weir was busier than expected handling the large runs of Dolly Varden, cutthroat trout, and steelhead (Yanusz 1997) and recovering regur-gitated radio tags in lower Sitkoh Creek. Consequently, we were unable to confirm if tagged cutthroat trout regurgitated transmitters and/or actually spawned in the watersheds where transmitters were detected.

DISCUSSION

Studies show that mature cutthroat trout migrate quickly from overwintering sites to natal spawning areas (Michael 1980, Trotter 1989). Because our tagged fish migrated without hesitation to

Table 2.–Comparison of cutthroat that retained

their tags and fish that regurgitated tags in the Sitkoh Creek study, 1996.

Successfully tagged cutthroat trout:

		Length (mm)		
Sex	No.	Min.	Max.	Avg.
F	19	318	432	377
M	19	310	400	360
Unknown	4	323	374	356
Total	42	310	432	367

Cutthroat trout that regurgitated radio tags:

		Length (mm)		
Sex	No.	Min.	Max.	Avg.
F	19	309	460	353
M	11	315	405	350
Unknown	1	325	325	325
Total	31	309	460	351

nearby streams, and because they were mature,we believe it reasonable to assume they were migrating to these locations to spawn. Repeated attempts to determine the status of tagged fish released with transmitters have been foiled by logistical difficulties. One aid might be to incorporate mortality sensors to allow aerial surveyors to determine if the tags are regurgitated or the fish has expired. Other studies on salmon, however, suggest that approach may also prove unreliable (Bendock and Alexandersdottir 1992, Johnson et al. 1992).

We estimate that 94% of the mature emigrants from Sitkoh Lake were destined for Sitkoh River, a drainage that has been substantially modified by clearcut logging activities that were conducted in the 1970s and then again in the early 1990s. Of the total timber area in the watershed, 32% has been clearcut, with most of the harvest in the stream corridor. Studies cited by Behnke (1992),

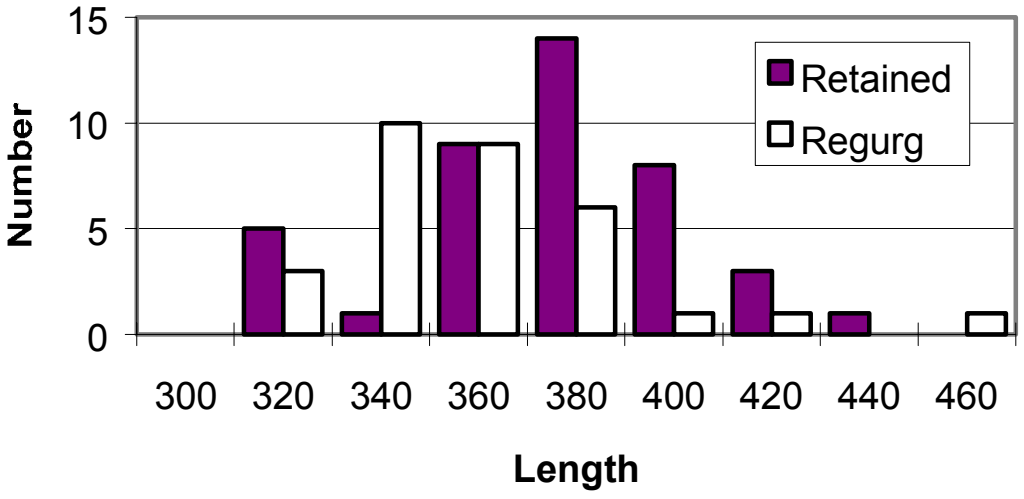

Figure 4.–Length frequency of cutthroat trout that retained radio tags and length frequency of those that regurgitated radio tags.

Table 3.–Daily cutthroat trout outmigration and tagging fraction by date for Sitkoh Creek, 1996.
Cutpoints for temporal strata are shown by underlined text.

Date	Daily outmigration	Cum	Successfully tagged	Cum	Cum %	Fraction tagged (percent)
4/10/96	1	1		0	0%	
4/11/96	3	4		0	0%	
4/14/96	1	5		0	0%	
4/15/96	12	17		0	0%	
4/16/96	34	51	4	4	8%	8%
4/17/96	37	88	7	11	13%	19%
4/18/96	7	95		11	12%	
4/19/96	18	113		11	10%	
4/20/96	22	135	5	16	12%	11%
4/21/96	2	137		16	12%	
4/22/96	52	189	4	20	11%	7%
4/23/96	18	207	6	26	13%	33%
4/24/96	7	214	3	29	14%	43%
4/25/96	81	295		29	10%	
4/26/96	19	314	6	35	11%	6%
4/27/96	27	341		35	10%	
4/28/96	2	343	3	38	11%	10%
4/29/96	177	520		38	7%	
4/30/96	120	640		38	6%	
5/1/96	33	673	8	46	7%	2%
5/2/96	92	765		46	6%	
5/3/96	91	856	1	47	5%	1%
5/4/96	52	908	2	49	5%	4%
5/5/96	62	970		49	5%	
5/6/96	4	974	3	52	5%	5%
5/7/96	10	984		52	5%	
5/8/96	49	1033	3	55	5%	5%
5/9/96	46	1079		55	5%	
5/10/96	37	1116		55	5%	
5/11/96	77	1193	1	56	5%	1%
5/12/96	69	1262	1	57	5%	1%
5/13/96	59	1321		57	4%	
5/14/96	55	1376		57	4%	
5/15/96	13	1389	1	58	4%	1%
5/16/96	12	1401		58	4%	
5/17/96	6	1407		58	4%	
5/18/96	14	1421		58	4%	
5/19/96	1	1422		58	4%	
5/20/96	16	1438		58	4%	
5/21/96	3	1441		58	4%	
5/22/96	1	1442		58	4%	

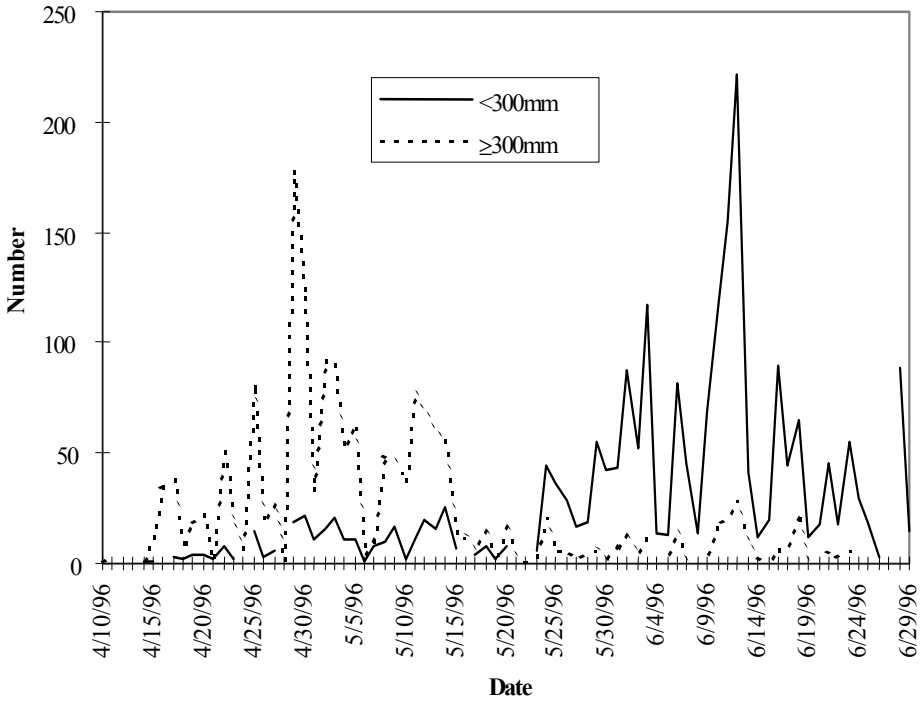

Figure 5.–Daily number of outmigrating cutthroat trout ≥300mm and number <300mm in length at Sitkoh Creek, 1996.

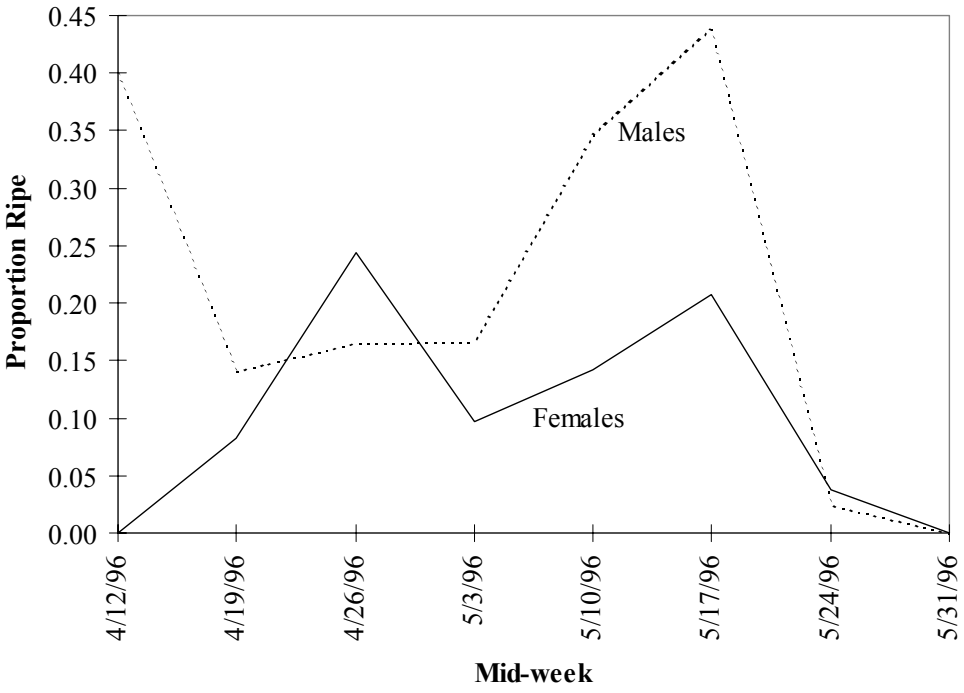

Figure 6.–Weekly proportion of obviously mature cutthroat trout passing down through the Sitkoh Creek weir.

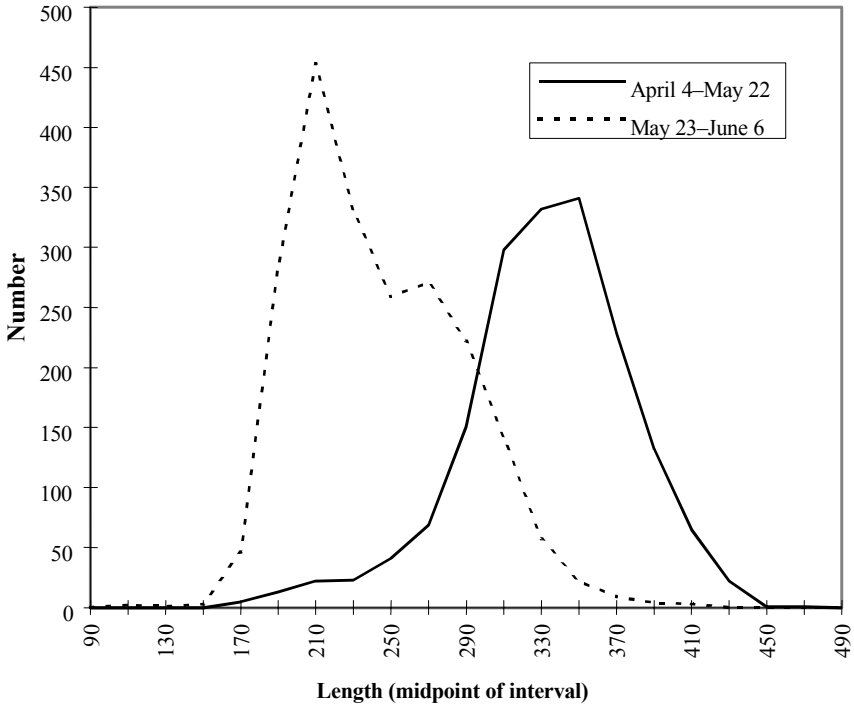

Figure 7.–Length frequency of cutthroat trout outmigrating in the early segment of the run (April 4–May 22) and later portions of the run (May 23–June 6).

Lucas (1980), and Martin et al. (1981) all indicate that cutthroat trout are highly vulnerable to habitat alteration from clearcut logging. Consequently, production of cutthroat trout from Sitkoh River may have been reduced or could decline in the future. At the current time, the stock appears to be the single largest contributor to overwintering stocks in Sitkoh Lake.

One fish leaving Sitkoh Creek carried a Floy tag applied at Lake Eva in the spring of 1995. Although this fish was given a radio tag at the time of its emigration it was regurgitated in lower Sitkoh Creek. When tagged at Lake Eva on June 10, 1995 it was listed in the field notes as an immature male 285 mm in length. When measured again May 11, 1996 and it was listed as a mature female at 332 mm FL (an increase of 47 mm in length).

We recommend that future studies seek an alternative to implanting radio tags in the stomachs of sea-run coastal cutthroat trout. After holding fish for 24 hours, regurgitation rates of 43% still occurred before (or as) fish entered salt water about 90 meters downstream of the weir.

However, comparison of lengths, sex, and relative emigration times of cutthroat that regurgitated their tags provides little information for guiding future programs. Fish that regurgitated tags tended to be female and smaller than those that retained tags but the differences in the retention rates were not large.

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APPENDIX A

Appendix A1.–Cutthroat trout radio-tagged and released at the Sitkoh Creek weir in 1996.

Date	Fork length	Floy tag	Transmitter frequency	Code	Regurg[a]	Sex	Apparent maturity[b]	Comments
4/13/96	357	3007	152.584	17	1	M		
4/16/96	370	3017	152.282	17			unknown	Tag lost— never heard again
4/17/96	400	3024	152.073	17		M		
4/17/96	370	3061	152.524	17		M		
4/17/96	375	3056	152.554	17	1	F		
4/17/96	360	3040	152.584	17		M		
4/18/96	400	3071	152.524	14		F		
4/18/96	365	3029	152.554	14	1	F		
4/18/96	403	3034	152.584	14		F		
4/18/96	310	3051	152.584	19		M		
4/18/96	350	3065	152.644	14		M		
4/21/96	400	3139	152.524	19		F	mature	
4/21/96	415	3126	152.584	18		F		
4/21/96	385	3115	152.614	14		M		
4/21/96	-	-	152.554	18		-	unknown	Tag lost— never heard again
4/23/96	390	3165	152.524	18		M		
4/23/96	370	3164	152.554	19		M		
4/24/96	315	3198	152.013	14	1	M		
4/24/96	330	3231	152.194	14	1	M		
4/24/96	365	3174	152.223	14	1	F		
4/24/96	370	3222	152.254	14		F		
4/24/96	405	3210	152.314	14	1	M		
4/24/96	370	3186	152.344	14	1	F		
4/25/96	340	3242	152.045	14	1	M		
4/27/96	361	3323	152.013	17		M		
4/27/96	334	3333	152.045	17	1	F		
4/27/96	358	3264	152.103	14	1	M		
4/27/96	361	3348	152.103	17		M		
4/27/96	380	3276	152.134	14		M		
4/27/96	384	3252	152.164	14		M		
4/27/96	352	3287	152.164	17	1	M		
4/27/96	359	3299	152.254	17		M		
4/27/96	374	3309	152.344	17	1	M		
4/29/96	325	3397	152.134	17	1	F		
4/29/96	352	3359	152.194	17	1	F		
4/29/96	325	3386	152.223	17	1	F		
4/29/96	382	3350	152.314	17		F		
4/29/96	316	3375	152.344	17		M	mature	
5/2/96	366	3541	152.045	18		M		
5/2/96	372	3407	152.103	18		F		
5/2/96	365	3496	152.134	18	1	F		
5/2/96	386	3589	152.164	18		F		
5/2/96	360	3636	152.194	18		M		
5/2/96	340	3452	152.223	18	1	M		
5/2/96	350	3732	152.223	19	1	F		
5/2/96	460	3687	152.344	18	1	F		
5/4/96	382	3890	152.013	18	1	F		
5/4/96	350	3836	152.103	14	1	F		

-continued-

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Date	Fork length	Floy tag	Transmitter frequency	Code	Regurg[a]	Sex	Apparent maturity[b]	Comments
5/4/96	342	3843	152.254	18	1	F		
5/4/96	350	3795	152.314	18		F		
5/5/96	432	3916	152.194	19		F		
5/5/96	320	3971	152.194	17		M		
5/7/96	315	4501	152.103	19	1	F		
5/7/96	365	4549	152.164	19		F		
5/7/96	355	4615	152.254	19		F		
5/7/96	318	4614	152.344	19		F		
5/9/96	357	4651	152.045	19		F		
5/9/96	410	4701	152.134	19		F		
5/9/96	309	4638	152.314	19	1	F		
5/12/96	343	4756	152.014	19	1	F		
5/12/96	342	4799	152.223	19		F		
5/13/96	356	4901	152.103	14		F		
5/13/96	332	1983	152.194	14	1	F	mature	Lake Eva tag
5/13/96	325	4943	152.344	18	1	M	mature	
5/16/96	370	4996	152.223	17		M		
5/16/96	380	3109	152.254	18		F		
5/18/96	366	3152	152.045	17		F		
5/18/96	340	3160	152.194	14	1	F		
5/24/96	354	3232	152.554	17	1	M		
5/30/96	320	3431	152.223	14		M		
6/5/96	374	3878	152.344	14			unknown	Tag lost— never heard again
6/12/96	323	2833	152.194	14			unknown	Tag lost— never heard again
6/14/96	325	3970	152.344	18	1			

[a] Regurg 1= Tag regurgitated and recovered.

[b] Apparently mature determined visually at the time of migration through the weir.

[c] This fish was tagged leaving Lake Eva in 1995 and overwintered in Sitkoh Lake in 1996.

Appendix A2.–Aerial radio tag tracking results for the Sitkoh Creek study, 1996. 'X' indicates the transmitter signal was detected in a survey on that date.

			DATE										
Frequency	Code	Stream number	4/19/96	4/23/96	5/2/96	5/8/96	5/15/96	5/22/96	5/29/96	6/5/96	6/12/96	6/19/96	6/26/96
152.013	14	113-59-10070			X	X	X	X	X	X	X	X	X
152.013	17	113-59-10070			X		X	X			X	X	X
152.045	18	113-59-10070				X	X	X	X	X	X	X	
152.103	14	113-59-10070					X	X	X	X	X	X	X
152.103	17	113-59-10070				X	X		X	X	X	X	
152.103	18	113-51-10060						X	X	X	X	X	X
152.134	14	113-59-10070				X		X		X			
152.134	19	113-59-10070					X	X	X	X	X	X	
152.164	14	113-59-10070				X	X	X	X	X	X		
152.164	18	113-51-10048				X	X	X	X	X	X	X	X
152.164	19	Sitkoh Bay on beach				X	X	X	X	X	X	X	X
152.194	18	113-59-10070				X		X		X		X	X
152.194	19	113-59-10070				X	X	X	X	X	X	X	X
152.254	14	113-59-10070				X	X	X	X	X	X	X	
152.254	18	113-59-10070						X		X	X	X	X
152.254	19	113-59-10070					X	X	X	X	X	X	X
152.314	14	113-59-10070				X							
152.314	17	113-59-10070				X	X	X	X	X	X	X	X
152.344	14	113-59-10070									X	X	X
152.344	17	113-51-10048			X	X	X	X	X	X	X	X	X
152.524	14	113-59-10070		X	X	X	X		X	X	X		
152.524	17	113-59-10070		X							X	X	X
152.524	18	113-59-10070			X	X	X	X	X	X	X	X	X
152.524	19	113-59-10070		X	X	X	X	X	X	X	X	X	X
152.554	14	113-59-10070			X	X	X		X	X			
152.554	18	113-59-10070			X			X					
152.584	14	113-59-10070			X	X	X	X	X	X	X	X	X
152.584	17	113-59-10070	X	X	X	X	X	X		X	X	X	
152.584	18	113-59-10070		X		X	X	X	X	X	X	X	X
152.614	14	113-59-10070		X	X	X	X	X	X	X	X	X	X
152.644	14	113-59-10070		X	X	X	X	X	X	X	X	X	X

Appendix A3.–Data files used to estimate parameters of the cutthroat trout radio-tracking studies at Sitkoh Creek. Data files have been archived at, and are available from the Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage, AK, 99518-1599.

File name	Description
Counts.xls	Data for the weir counts by species and day from Sitkoh Creek, 1997.
St_radio.xls	Data for the radio tracking study at Sitkoh Creek..